eHealth Global Technologies, Inc.
140 Allens Creek Road
Rochester, NY 14618

MAIN 877.eHGT.999
FAX 866.848.1263

www.eHGT.com

Benefits of Image-Enabling RHIOs and HIEs

By Ken H. Rosenfeld, President and CTO, eHealth Global Technologies

An eHealth Global White Paper

Introduction

With the recent proliferation of health information exchanges (HIEs) and interoperability, invigorated by the American Recovery and Reinvestment Act of 2009 and Meaningful Use Stage 2 and later requirements, Regional Health Information Organizations (RHIOs), Integrated Delivery Networks (IDNs) and other healthcare providers that are implementing an HIE must carefully prioritize their efforts so that they continually improve patient care, increase efficiency, and reduce costs in order to achieve long term sustainability. They understand that these benefits can be most readily realized through reducing unnecessary or duplicative procedures, reducing medical errors, eliminating unnecessary non-value-add processes, and speeding up patient care while simultaneously enabling healthcare resources to be better leveraged across the community. One of the most important elements of the healthcare chain that can dramatically impact all of these areas is medical imaging. However, until very recently imaging has been either postponed or all but ignored as a component of HIEs for several reasons:

- Perceptions that exchanging images is technically difficult to accomplish;
- A belief that exchanging images is cost-prohibitive and does not provide an adequate return on investment;
- Concerns that community Radiology providers will not consent to “handing over” the images they have created and diagnosed; and therefore,
- A resulting concern that exchanging images may in the end negatively impact the sustainability of the HIE.

Until recently, these were all accepted as legitimate reasons to relegate the implementation of image exchange to the bottom of the priority list for HIE efforts. This paper explores how the latest innovative advances in technology have rendered these concerns all but obsolete, and as a result why image exchange should now be one of the highest priorities for any organization, public or private, in implementing an HIE.

The Challenges

The inability to access required medical information for ongoing care of patients, as they traverse from provider-to-provider across a community, creates significant additional cost, and negatively impacts patient care. For example, an April 2011 study published in the journal *Radiology, Sodickson et al.* states

that a 17% decrease in emergency room medical imaging procedures could be realized if access to prior imaging studies was provided to the ER physicians. The study also indicated that only 78% of imaging CDs were readable by the hospital's system when they tried to access prior studies.

The overall impact of unnecessary duplicate imaging in all healthcare settings, including the ER, warrants further exploration. When patient imaging studies are not accessible or shared, yet are required for patient care, the most common mitigation is to repeat that imaging exam. These inappropriate and duplicate imaging procedures add between $3B to $10B annually to healthcare costs in the US, according to a report by *America's Health Insurance Plans*. A study reported in the November 2007 issue of the *New England Journal of Medicine* showed that one-third of CT exams are unnecessary, and that overuse of diagnostic CT scans may cause as many as 3 million excess cancers in the US over the next three decades. Clearly, in addition to the excessive costs, this highlights a serious health issue that should qualify imaging to be one of the top priorities for anyone implementing an HIE.

It is logical to expect that the ubiquity of the Digital Imaging and Communications in Medicine (DICOM) imaging standard, coupled with market saturation of Picture Archive and Communication Systems (PACS) over the last decade should have made image exchange more readily available than it is. However, there are a number of reasons why this has not occurred:

- The DICOM standard was implemented by vendors in different ways, creating a host of new challenges for users attempting to share this information across multiple environments that utilize multiple imaging vendors.
- The large file sizes of image data, sometimes reaching hundreds of megabytes per exam, which is common in multi-slice CT studies, has made it difficult to efficiently and cost-effectively transfer imaging over the variety of networks installed in healthcare institutions and physician practices.
- DICOM does not include built-in security, and many PACS do not offer the ability to restrict external users to see just the exam of interest, without also "opening the door" to accessing all exams on that PACS. This can make it nearly impossible to enforce patient consent rules that are needed in community-wide information exchanges.
- Today, most image information is shared via physical media such as CD or DVD, and then passed directly to clinicians in need of viewing the image data. Physical storage media is easily lost and frequently creates a plethora of usability, security and IT support issues since it usually requires installation of a compatible viewer. Clinicians therefore are forced to deal with multiple viewing environments, one for each PACS vendor, making the "simple" task of viewing diagnostic quality medical images and uploading them into their existing PACS environments a near impossibility.
- Web-based access directly into a PACS is typically limited to users who are affiliated with the institution that implemented the PACS, for good reasons. For an external community-based clinician needing access to multiple PACS environments in different facilities over the Internet, many of the same challenges as sharing physical media exist. Multiple viewing environments are still needed, several different sets of user credentials are usually necessary, and each facility's IT network security can change on a daily basis making it impractical for a busy physician or specialist to manage effectively. On top of these burdens to users, the PACS image hosting institutions also must often manage hundreds or even thousands of outside users demanding access to their Web-based environment in order to have the access to images they need to provide appropriate patient care.
- Even some of the more advanced cloud-based image sharing services on the market today suffer from the limitation of an inability to render images in conjunction with a "complete" patient record that spans across regional healthcare providers, since they are not integrated with the broader HIE. Image exchange requests using these services are often made in an "ad-hoc" manner, with

long wait times while the images are retrieved from local storage. User authentication and patient consent must still be managed independently from what may already be in place for the HIE. Furthermore, the technical challenges of multiple cloud-based image viewers that may not be compatible with each other will still exist, and users may not be able to view images side-by-side from more than one image provider. As with more traditional web-based viewing, the need to remember multiple logins and passwords for several of these "stand-alone" cloud services can often complicate usage to the point of making them impractical for everyday use.

Recent technology advances, applied with the aim of image-enabling HIEs rather than working independently of them, can now overcome these challenges in a cost-effective manner. These latest advances enable rapid, secure access to all of a patient's images in one diagnostic quality viewer, regardless of how many imaging providers they originated from, and all from within the context of a patient's complete medical history. They deliver benefits to the PACS image providers as well, since these providers are once and for all relieved of the burden of image distribution to referring physicians and image-intensive specialists using physical media, as well as the cost and security issues that so often accompany the directly opening up their PACS to large numbers of community-wide web viewing users.

A Solution: "Hybrid Federated Architecture Image Exchange"

Most of the traditional image exchange solutions discussed above have pursued a *federated* architecture that maintains all image storage at the source, and provides the exchange of images either by enabling single sign-on access to various PACS Web viewers, or on an "ad-hoc" basis via independent cloud-based image sharing services. These approaches, however, do not overcome the biggest barriers to adoption that are discussed above.

A ***Hybrid Federated Architecture Image Exchange*** eliminates most, if not all, of these issues by creating a centralized temporary cache (storage) of recent image exams. When applied as an integral part of the HIE, rather than as a stand-alone image exchange service, this architecture delivers nearly instant access to diagnostic images, all within the context of a patient record, leveraging the highly-refined security and patient consent rules that have already been established for the HIE. This approach also allows for the use of a single, common viewing environment, which simplifies training and ease-of-use, and reduces the impact to information technology infrastructure. The benefits are further assured by coupling this hybrid federated architecture with an image viewing technology that is appropriate for an HIE-wide image exchange. This viewing technology utilizes secure, adaptive streaming and server-side computing, permitting users with very light client platforms and less than fast networks to realize reliable, speedy image viewing performance, as they are essentially working with a "view" of the running application which resides in a secure data center. This combination of architecture with image viewing technology also guarantees that Protected Health Information (PHI) is never loaded onto a user's computer, and helps ensure that most workstations/viewers deployed in a healthcare environment, including a clinician's home, are capable of displaying even the largest-size imaging study in fully-diagnostic quality quickly and at a low cost.

The image exchange architecture described in this paper is not intended to stand on its own. To be truly effective, it must work seamlessly with the "master" HIE software solution. That "master" HIE software solution will process the exchange of all other types of healthcare data, as well as manage authentication, audit trails, master patient indexes, and patient consent management, none of which will need to be replaced when the HIE is "image-enabled".

More specifically, the advent of this *hybrid federated architecture* yields measurable benefits to HIEs and RHIOs that are seeking to add imaging to their portfolio of services, including:

- *Lower up-front capital costs* due to the need to deploy only the additional storage that will be utilized, as well as simplified integration requirements resulting from the incorporation of industry standards;
- *Lower licensing and support costs*, because of the single common viewer needed for accessing imaging exams, regardless of the Radiology and/or PACS vendor or where the study originates;
- *Lower ongoing costs for the Radiology providers*, since there is no longer a need to produce and distribute image media for referring physicians and specialists, there is no need to manage a large number of community-wide web users, lower overall bandwidth utilization can usually be expected for the institution, and the costs associated with "contributing" concurrent-use user licenses are usually all but eliminated;
- *Greater efficiencies and speed-to-care for users* due to the high-speed access to all recent image exams, while still guaranteeing seamless access to any prior imaging exam(s) that reside on the Radiology providers' PACS;
- *Secure, simplified workflow* because of the one-to-one linkage between the HIE's Radiology reports and viewing of the images that formed the basis of the report;
- *Reduced security risks at a lower cost* as the appropriate security mechanisms to prevent unauthorized access by community HIE users to PACS worklists and patient data without prior consent can be readily enforced; and,
- *Better patient care* thanks to the ability to view and process complex image exams, including 3D volume rendering and digital subtraction angiography, without requiring additional computing horsepower for the desktops/workstations used to view images.

HIE Integration of Image Exchange

As already noted, the architecture described in this paper requires that the image exchange integrate seamlessly with the existing HIE system. The recommended approach to accomplishing this is to implement a Service Oriented Architecture (SOA) which is commonly used for deployment of systems that require various outside services that are needed to provide a complete solution.

One of the challenges that many HIE software and services providers worry about is that exchanging and viewing of medical images, particularly in the heterogeneous environment of healthcare information technology, cannot be leveraged easily using standard Web services, due to the onerous bandwidth and processing requirements required for the display of full fidelity clinical imaging exams. To alleviate this concern, the hybrid federated architecture described herein leverages a small client application that resides on the user's computer to access the "view" of imaging exams contained alongside the image rendering applications running in a secure data center. As a result, viewing of diagnostic quality images becomes completely transparent to the HIE, while the interaction to authorize and access the image exam is managed through straightforward SOA Web services.

Providing a Breadth of Services for Any Clinical Workflow Scenario

The most common workflow scenario that requires image exchange capabilities is the viewing of an image exam that has already been reported on by the originating radiology provider, usually by an outside specialist, clinician or referring physician who is managing that patient's care. However, there are other workflows that this architecture supports:

- Emergent/Trauma Workflow

  Emergent/Trauma workflow is “pre-reporting” workflow, that is utilized when an imaging exam must be provided to a clinician in advance of that image being reported on by a radiologist. One such scenario would be the need for emergency consultation with a remote clinician (e.g., a neurologist who is consulting on a stroke patient that presents at a rural facility at 3 am); while another scenario would involve the need for images to precede a patient that is being transferred to a different healthcare facility.
  This hybrid-federated architecture approach manages this workflow by allowing the site that originated the medical image exam to forward the exam (via DICOM) to a special “emergent” destination that is part of the Image Exchange. Upon seeing a new study in this location, thanks to the adoption of SOA Web Services, the service will notify the HIE and provide for the immediate viewing of this exam.

- Forward to PACS

  Sometimes, particularly for Radiologists, just viewing an exam is not sufficient, and there is a need to download the full-fidelity image to an existing PACS or imaging workstation. This can be handled via a “forward to PACS” feature, which can also be implemented thanks to this approach. This allows the DICOM transfer of images into the user’s PACS system or imaging workstation (e.g., a specialized 3D processing workstation). This feature can be tied into the HIE with the appropriate controls and authorizations to ensure that the provider of the images, the facility in which the user is practicing, and the users themselves are all authorized to enable the transfer. Because this approach integrates tightly with the HIE, these necessarily sophisticated controls can be implemented across a community one time, thus preventing unauthorized access to images and potential harm to radiology practices with minimal added complexity.

- Access to Images from 3rd-Party EMRs

  While HIEs typically provide portals and their own EMR applications, HIEs also play a key role in coordinating the movement of clinical data between healthcare providers, including ensuring that healthcare data is accessible from a user’s own EMR. Diagnostic image access can also be provided as part of this workflow, through the delivery of a secure web-link (URL). Access to images through this link brings all the capabilities of the hybrid-federated architecture, but directly to a user’s EMR environment. Viewing is managed from the same community-wide common viewer. As long as the EMR is able to handle external links (URLs), this functionality allows the deployment of image exchange into any HIE radiology reporting workflow.

Viewing of Medical Data

One of the most powerful capabilities of this *hybrid-federated architecture* is the ability for any authorized clinician to see most images literally within seconds, whenever and wherever needed, even at 2 AM in a remote clinic far, far away from the image source. Other approaches that rely on downloading image information upon request can create delays of many minutes or longer before the imaging exam is available for viewing, which will not be acceptable in critical clinical situations. These same “time to view” issues exist when caregivers attempt to launch a CD viewer that is incompatible with another client application, when user names and passwords are lost, and when these same caregivers encounter a viewer application that the clinician has never used before. All of these unacceptable situations are eliminated by the HIE-wide approach to viewing described in this paper, thanks to the hybrid-federated architecture, the seamless integration with the HIE, and especially the intelligent choice of a common HIE-wide image viewing technology.

Sometimes the more traditional image exchange approaches have attempted to mitigate the challenges described above by compressing images to a fraction of their original size and fidelity. A referred patient's medical data, particularly for specialties such as Oncology and Surgery, can be quite image intensive. Compressing images in a JPEG format is not sufficient for clinical viewing by these specialists, as there is a loss of image information and severe limitations on viewing (particularly for cross-sectional imaging exams).

To provide an effective service for these specialties, the imaging must be displayed in full diagnostic quality and it must be provided with a suite of imaging tools to enable magnification, panning, adjustment of window and level (similar to brightness and contrast), measurements, including line and region of interest, and image enhancement such as enhanced sharpness. Viewing JPEG images in an HIE simply does not provide these capabilities, and enabling community-wide access directly into PACS, while it can potentially provide the required fidelity and imaging tools, is unnecessarily complex, and adds significant training challenges in addition to the issues outlined on page one of this paper.

However, the server-side computing technology that assures the security of seeing only the "view" of the data also enables viewing of full-diagnostic quality imaging. Plus, thanks to the incorporation of image streaming, this viewing can occur over lower bandwidth connections, such as residential or cellular broadband, while maintaining fast image response time and user access to all of the imaging tools mentioned above. Additionally, thanks to a well thought-out GUI, the viewer is easy to use for a casual clinical user, yet has a complete suite of clinical features and processing tools for the image-intensive specialist. This allows any clinician to work with the full diagnostic quality images and perform any diagnostic post-processing of the image data.

Finally, from an IT perspective, this image viewing technology has no dependency on the version of browser, Java, or ActiveX controls – ensuring virtually any user can access images quickly, even if it is the first time they have needed to do so.

Conclusion

Using traditional HIE solutions, stand-alone image exchange services, or relying on inherent PACS capabilities for image exchange across a community creates a new host of challenges and issues that until very recently has not been effectively overcome. Healthcare providers have continued to struggle to maintain data security and patient privacy in a simple and cost-effective way; they frequently have resorted to viewing limited fidelity images with insufficient clinical viewing and image manipulation tools; they end up consuming inordinate levels of IT resources to manage outside access to images for users; they struggle with complex interoperability and/or integration challenges across multiple facilities and imaging vendors; all the while devouring precious bandwidth in an attempt to maintain acceptable access to large image data files.

A Hybrid Federated Architecture Image Exchange eliminates these issues by integrating seamlessly with an existing HIE to simplify workflow and support costs, and by leveraging a centralized cache of the image exams anticipated to be most frequently accessed by the user community. A single, common viewing environment that is easy-to-use, simplifies training and reduces the impact to IT infrastructure is key to this solution. Incorporating the right clinical image viewing technology streamlines the secure viewing of the application and images, and provides the required clinical tools to manipulate and post-process even the largest-size image data sets. Simplified integration and limited storage needs of this hybrid approach reduce upfront capital investment, resulting in a cost-effective image exchange service that assures secure access to images while contributing to the return on investment needed to drive long-term sustainability.

eHealth Global has deployed its eHealth Connect® Diagnostic Image Exchange utilizing a hybrid federated architecture in functional HIE environments. This is a unique solution in the industry today, and makes implementing an Image Exchange much more attainable and cost effective than many people in

the healthcare industry realize. Find out more about eHealth Global's eHealthConnect Image Exchange at www.eHGT.com, or by contacting eHealth Global at info@ehgt.com, or by calling 877-344-8999.